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The results given in this paper must only be considered as of a preliminary character. I intend to make a more thorough investigation of the instrument as soon as I can do so without seriously interfering with my regular observations.

Royal Observatory, Cape of Good Hope:
1899 *January* 3.

The Greenwich Meridian Observations of Polaris, 1836–1893, *with reference to Personality, the value of the Constant of Aberration, and the Star's parallax.* By W. G. Thackeray.

Some years ago, when discussing the observations of *Polaris* with the view of obtaining a value of the nutation constant, the results were likewise arranged with the purpose of determining the annual errors, but it was afterwards found that to include the two discussions in one paper made it too cumbersome, and so the latter part was omitted and the papers have lain dormant since. In turning out some old papers I have lately come upon them, and I append this short preface as an explanation why the right ascensions are reduced in the present form, and how it is that reference is made below to personal equations.

The right ascensions here dealt with are those extending from 1836 to 1893, and are divided into two periods. The first includes the observations made with the transit instrument from 1836 to 1850, and the second those made with the transit circle from 1851 to 1893. They have been all reduced to the year 1890·0 with the Struve-Peters value of precession, with the adopted value of the proper motion for 1890 of $+0^{s}\cdot1550$, the value which was obtained from the discussion on the constant of nutation (*Mem. R.A.S.* vol. li.). They have further been corrected for personal equation to the adopted standard observer "C" by the quantities given in Table III. on p. 252 of the paper referred to above, a process which involved a considerable amount of work, and of which it seems desirable to preserve a record.

The values for any monthly mean are the combination of the results above and below pole, weighted according to the number of observations, and are given uncorrected for personality as well as corrected for personality.

The observations in January and February are mostly below-pole observations, those in July and August above-pole observations, but no observation is kept for place unless the azimuth error has been determined from the consecutive transits of one of the close circumpolars.

The observations have been taken direct from the "Greenwich Observations," and those for 1836–1850 have been corrected further to reduce them to the value of the aberration constant 20·445.

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Monthly Means of Right Ascensions of Polaris reduced to 1890. (*Adopted P.M.* + 0ˢ·1550 *for* 1890.)

I.—1836–1850. Transit Instrument. Uncorrected for Personality.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
	s	s	s	s	s	s	s	s	s	s	s	s
$\alpha' =$	$33{\cdot}22_{70}$	$33{\cdot}09_{22}$	$33{\cdot}62_{14}$	$32{\cdot}31_{167}$	$31{\cdot}88_{185}$	$31{\cdot}49_{131}$	$30{\cdot}80_{50}$	$30{\cdot}44_{78}$	$30{\cdot}24_{130}$	$32{\cdot}30_{110}$	$32{\cdot}51_{157}$	$32{\cdot}54_{93}$
$\alpha =$	31·91	...	...	...	...	...	...	...	...	...	...	...
$\alpha' - \alpha$	+ 1·31	+ 1·18	+ 1·71	+ 0·40	− 0·03	− 0·42	− 1·11	− 1·47	− 1·67	+ 0·39	+ 0·60	+ 0·63

II.—1836–1850. Transit Instrument. Corrected for Personality.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
α'	32·27	32·13	32·72	31·56	30·95	30·80	30·04	29·89	29·59	31·47	31·64	31·76
α	31·13	...	...	...	...	...	...	...	...	...	...	...
$\alpha' - \alpha$	+ 1·14	+ 1·00	+ 1·59	+ 0·43	− 0·18	− 0·33	− 1·09	− 1·24	− 1·54	+ 0·34	+ 0·51	+ 0·63

III.—1851–1893. Transit Circle. Uncorrected for Personality.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
α'	$31{\cdot}90_{125}$	$31{\cdot}82_{92}$	$31{\cdot}45_{338}$	$31{\cdot}20_{495}$	$30{\cdot}66_{317}$	$30{\cdot}74_{338}$	$30{\cdot}97_{133}$	$31{\cdot}18_{101}$	$30{\cdot}72_{479}$	$31{\cdot}07_{169}$	$31{\cdot}24_{399}$	$31{\cdot}51_{246}$
α	31·10	...	...	...	...	...	...	...	...	...	...	...
$\alpha' - \alpha$	+ 0·80	+ 0·72	+ 0·35	+ 0·10	− 0·44	− 0·36	− 0·13	+ 0·08	− 0·38	− 0·03	+ 0·14	+ 0·41

IV.—1851–1893. Transit Circle. Corrected for Personality.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
α'	31·44	31·66	31·59	31·35	30·97	30·81	31·04	31·01	30·46	31·15	31·32	31·66
α	31·14	...	...	...	...	...	...	...	...	...	...	...
$\alpha' - \alpha$	+ 0·30	+ 0·52	+ 0·45	+ 0·21	− 0·17	− 0·33	− 0·10	− 0·13	− 0·68	+ 0·01	+ 0·18	+ 0·52

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Comparing the results deduced with and without a correction for personality, it is apparent that such a correction is not justified by the little smoothing that is made, and seems to show that at Greenwich, where there are many observers engaged in observing, personality works little or no harm in the course of a year.

It is also clear that the results obtained with the transit circle are very superior to those obtained with the transit instrument. Therefore the transit-circle results alone are used in the rest of this paper, and those uncorrected for personality (III.).

Now let K be the correction to the adopted constant of aberration 20″·445, and let P be the star's parallax, α' the apparent and α the mean R.A.; then we have (Chauvenet, vol. i. pp. 633 and 645):—

$$\begin{aligned}\alpha'-\alpha = &-\mathrm{K}\sec\delta\,(\cos\odot\cos\epsilon\cos\alpha+\sin\odot\sin\alpha)\\ &-\mathrm{P}\sec\delta\,(\cos\odot\sin\alpha-\sin\odot\cos\epsilon\cos\alpha).\end{aligned}$$

Then, assuming that no appreciable error will be introduced by taking the value of the Sun's longitude for the middle of each month—or, in other words, that the monthly means correspond fairly to the mean date of the month—and giving a weight of 1 to every hundred observations, we get the following series of equations:—

Right Ascensions.

		s	W.
− 3·1 K	−41·5 P	= +0·80	1
−24·4	−33·8	= +0·72	1
−37·2	−18·5	= +0·35	3
−41·4	+ 3·0	= +0·10	5
−34·8	+22·8	= −0·44	3
−18·8	+37·0	= −0·36	3
+ 1·2	+41·6	= −0·13	1
+21·6	+35·5	= +0·08	1
+36·5	+19·9	= −0·38	5
+41·5	− 0·8	= −0·03	5
+35·3	−21·9	= +0·14	4
+19·2	−36·8	= +0·41	2

$$\begin{aligned}39179\,\mathrm{K}-2295\,\mathrm{P}&=-47^{s}{\cdot}31\\ -2295\,\mathrm{K}+19685\,\mathrm{P}&=-224{\cdot}91\end{aligned}$$

whence

$$\begin{aligned}\mathrm{P}&=-0^{s}{\cdot}012\\ \mathrm{K}&=-0{\cdot}002\end{aligned}$$

which give

Aberration.	Parallax.
20″·42	−0″·17

The value of the parallax from the right ascensions is thus negative, showing that the observations are affected by some other annual term.

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We now come to the declinations.

The observations are those made with the transit circle from 1851 to 1893, and thus comprise six complete periods of Chandler's latitude variation. The observations are all reduced on one system, that in present use, and have been corrected for the newly determined values of division errors, which are, generally speaking, for *Polaris* 1851–1877 $''{\cdot}00$, and for 1878–1893 $+0''{\cdot}25$, *Polaris* S.P. 1851–1856 $+0''{\cdot}10$, 1857–1877 $-0''{\cdot}10$, and for 1878–1893 $''{\cdot}00$. The observations from 1868 to 1876 have also been corrected for the wear in the microscope micrometer screws.

The observations are all reduced to 1890 with an adopted proper motion of $-0''{\cdot}005$.

Monthly Means of Declinations of Polaris 1851–1893 *reduced to* 1890. (*Adopted P.M.* $-0''{\cdot}005$.)

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
$\delta' =$	$18''{\cdot}65_{342}$	$18''{\cdot}45_{253}$	$18''{\cdot}26_{467}$	$18''{\cdot}09_{683}$	$18''{\cdot}15_{727}$	$18''{\cdot}25_{603}$	$18''{\cdot}68_{385}$	$18''{\cdot}79_{358}$	$18''{\cdot}63_{331}$	$18''{\cdot}54_{623}$	$18''{\cdot}49_{580}$	$18''{\cdot}57_{471}$
$\delta =$	18·42	...	...	...	...	...	...	...	...	...	...	...
	+ 0·23	+ 0·03	− 0·16	− 0·33	− 0·27	− 0·17	+ 0·26	+ 0·37	+ 0·21	+ 0·12	+ 0·07	+ 0·15

Let K be the correction to the adopted constant of aberration, P the star's parallax, δ' and δ the apparent and mean declination, then by Chauvenet, vol. i. p. 633,

$$\delta' - \delta = -K \cos \odot\,(\sin \epsilon \cos \delta - \cos \epsilon \sin \delta \sin \alpha) - K \sin \odot \sin \delta \cos \alpha - P \sin \odot\,(\cos \epsilon \sin \delta \sin \alpha - \sin \epsilon \cos \delta) - P \cos \odot \sin \delta \cos \alpha.$$

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Then, assuming the value of the Sun's longitude as before, we get the following series of equations :—

			Declinations.	W.	C—O	$+''\cdot17 \sin 2\odot$
+1·00 K	−0·13 P	=	+0″·23	3	−0·22	−0″·13
+0·77	−0·63	=	+0·02	3	−0·14	−0·16
+0·38	−0·91	=	−0·19	5	·00	−0·03
−0·13	−0·98	=	−0·31	7	+0·07	+0·13
−0·60	−0·79	=	−0·27	7	+0·07	+0·16
−0·91	−0·37	=	−0·17	6	+0·05	+0·03
−0·98	+0·09	=	+0·26	4	−0·28	−0·12
−0·81	+0·57	=	+0·37	4	−0·27	−0·16
−0·42	+0·90	=	+0·21	5	−0·02	−0·04
+0·08	+0·99	=	+0·11	6	+0·13	+0·12
+0·57	+0·81	=	+0·07	6	+0·13	+0·16
+0·90	+0·40	=	+0·15	5	−0·07	+0·04

$$23\cdot69\,K + 3\cdot56\,P = +1''\cdot71$$
$$+3\cdot56\,K + 34\cdot44\,P = +8\cdot13,$$

whence

$$P = +0''\cdot23$$
$$K = +0\cdot037,$$

which give

Aberration.	**Parallax.**
20″·49	+0″·23.

The residuals C—O appear to demonstrate the existence of a six months' term, which can be fairly expressed by the formula $+''\cdot17 \sin 2\odot$, and which appears to be consistent and persistent throughout the period, for it is found that the values of the coefficient for the two periods 1851–1868 and 1869–1893 are +″·13 and +″·24 respectively. It will, however, be found that it does not affect the determined values of either the aberration or the parallax. In order to trace, if possible, the origin of this period the observations above and below pole have been separated, and the results given by Polaris and Polaris S.P. have both been discussed for the values of the aberration constant and for parallax. It will be seen that the aberration constant now differs considerably for the two determinations, the value from the above pole observations being the larger.

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Monthly variations in declination of Polaris and Polaris S.P., 1851–1893.

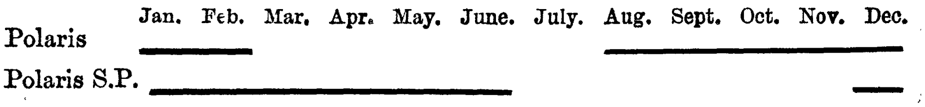
	Polaris.			Polaris S.P.			C–O	
	$\delta'-\delta$	No. of Obs.	Wt.	$\delta'-\delta$	No. of Obs.	Wt.	Polaris.	Polaris S.P.
January	+0″·28	278	5	+0″·17	64	1	−0″·27	−0″·16
February	+0·02	184	3	−0·07	69	1	−0·14	−0·05
March	−0·17	232	4	−0·28	235	4	−0·04	+0·07
April	−0·49	247	4	−0·20	435	7	+0·23	−0·06
May	−0·27	238	4	−0·32	489	8	+0·04	+0·09
June	−0·32	203	3	−0·13	400	7	+0·19	·00
July	−0·01	111	2	+0·35	274	5	−0·01	−0·37
August	·00	94	2	+0·53	264	4	+0·11	−0·42
September	+0·01	300	5	+0·39	236	4	+0·20	−0·18
October	+0·14	362	5	+0·17	267	4	+0·11	+0·08
November	+0·19	343	6	+0·05	237	4	+0·04	+0·18
December	+0·35	308	5	−0·13	163	3	−0·21	+0·27
Mean δ	18·47	2900	...	18·41	3125			

Equating as before, we get :—

	Aberration.	Parallax.
Polaris	20″·67	+0″·21
Polaris S.P.	20·30	+0·30
Mean	20·49	+0·26

The values of C – O in the table above are given for the mean values of the aberration and parallax. An inspection will show that the six months' term has apparently disappeared, and that the residuals for Polaris S.P. are large.

In the course of a year the observations of Polaris and Polaris S.P. between them are fairly distributed throughout the day and night, as will be seen from the following diagram, where the dark line represents the time when the observations are made between sunset and sunrise, and the absence of the line the time when they are made between sunrise and sunset :—



Rearranging the observations of Polaris and Polaris S.P. indiscriminately to represent daylight and night observations in

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accordance with this diagram, and giving each month the same weights as above, we get:—

	Aberration.	Parallax.
	$''$	$''$
Daylight	20·65	+0·21
Night	20·36	+0·34

It must be borne in mind that the observations of Polaris are peculiarly liable to anything like diurnal periods in the zenith-point corrections.

Note on Diurnal Variations of the nadir and level of the Transit Circle at the Royal Observatory, Greenwich.

(*Communicated by the Astronomer Royal.*)

Suspicion having been aroused as to the possibility of a variation in nadir of the transit circle depending on the hour of the day, observations of the nadir and level have been made at Greenwich three times a day on all fine days since the middle of 1895—once in the early part of the day, again as soon as observations were commenced in the evening, and finally at the end of the evening's work. These observations have been here arranged in three groups, each extending to six hours, viz. 21^h-3^h, 3^h-9^h, 9^h-15^h (astronomical reckoning), representing roughly the observations made about midday, about sunset, and at the end of the evening's work. Taking the results of the middle group 3^h-9^h as zero, the following table exhibits for each month the corrections to this group (that is, to the nadir observation made about sunset) derived from the observations made about midday and midnight:—